

## CLAIMS

What is claimed is:

- 1 1. A network device with a multi-layer management interface comprising:  
2 a first interface layer configured to  
3 receive a first set of messages from a first set of sources according to a  
4 first protocol;  
5 send a second set of messages according to a second protocol in  
6 response to said first set of messages; and  
7 send responses to said first set of sources according to said first  
8 protocol; and  
9 a second interface layer configured to  
10 receive a third set of messages from a second set of sources according  
11 to said second protocol, wherein said second set of sources  
12 includes said first interface layer and said third set of messages  
13 includes at least one message of said second set of messages;  
14 update configuration data of said network device in response to  
15 receiving said third set of messages; and  
16 send responses to said third set of sources according to said second  
17 protocol. A
- 1 2. The network device of Claim 1 wherein at least one of said first protocol and  
2 said second protocol is Hypertext Transport Protocol (HTTP).

1 3. The network device of Claim 2 wherein at least one of said first protocol and  
2 said second protocol is Simple Network Management Protocol (SNMP).

1 4. The network device of Claim 1 wherein:  
2 the second protocol is SNMP;  
3 the first interface layer includes an SNMP manager; and  
4 the second interface layer includes an SNMP agent.

1 5. The network device of Claim 1 further including a third interface layer  
2 configured to:  
3 receive commands from a user;  
4 send a fourth set of messages to said first interface layer according to said first  
5 protocol in response to said commands;  
6 receive responses to said fourth set of messages from said first interface layer  
7 according to said first protocol; and  
8 generate a display to said user based on messages received from said first  
9 interface layer according to said first protocol.

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1 6. The network device of Claim 5 wherein:  
2 the network device is connected to a second network device that includes  
3 a fourth interface layer,  
4 a fifth interface layer; and  
5 a second set of configuration variables;

6 the fourth interface layer is configured to  
7 receive messages from said third interface layer of said network device  
8 according to said first protocol;  
9 send messages to said fifth interface layer according to said second  
10 protocol in response to said messages from said third interface  
11 layer; and  
12 send responses to said third interface layer according to said first  
13 protocol; and  
14 the fifth interface layer is configured to  
15 receive messages from the fourth interface layer according to said  
16 second protocol;  
17 update configuration data of said network device in response to  
18 receiving messages from said fourth interface layer; and  
19 send responses to said fourth interface layer according to said second  
20 protocol.

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- 1 7. A method for managing a network device, the method comprising the steps of:  
2 executing a first software layer to generate a user interface;  
3 said first software layer receiving user input that specifies a change to  
4 configuration data stored in said network device;  
5 in response to said user input, said first software layer transmitting a first  
6 message to a second software layer using Hypertext Transport

7 Protocol, wherein said second software layer resides in said network  
8 device;  
9 in response to said first message, said second software layer transmitting a  
10 second message to a third software layer using Simple Network  
11 Management Protocol, wherein said third software layer resides in said  
12 network device; and  
13 in response to said second message, said third software layer changing said  
14 configuration data as specified by said user input.

1 8. The method of Claim 7 wherein the step of executing said first software layer  
2 is performed by executing a software layer that resides in said network device.

1 9. The method of Claim 7 wherein:  
2 the method further comprises the step of causing said second software layer to  
3 send a Hypertext Markup Language document to said first software  
4 layer; and  
5 the first software layer generates said user interface based on said Hypertext  
6 Markup Language document.

1 10. The method of Claim 9 wherein:  
2 the Hypertext Markup Language document contains an anchor that includes  
3 information identifying a Management Information Base object;

4 the step of said first software layer receiving user input that specifies a change  
5 to configuration data is performed by detecting when said user selects a  
6 user interface component associated with said anchor;  
7 the first message includes said information identifying said Management  
8 Information Base object;  
9 the second message includes said information identifying said Management  
10 Information Base object; and  
11 the step of changing said configuration data includes changing configuration  
12 data that corresponds to said Management Information Base object.

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1 11. The method of Claim 9 further comprising the step of causing said second  
2 software layer to generate said Hypertext Markup Language document by  
3 performing the steps of:  
4 receiving an object identifier for a Management Information Base object;  
5 using said object identifier to search one or more files for entries associated  
6 with said Management Information Base object; and  
7 for each entry associated with said Management Information Base object,  
8 generating Hypertext Markup Language text that, when decoded by an  
9 HTTP client, will cause the client to display information contained in  
10 said entry.

1 12. The method of Claim 11 wherein the step of using said object identifier to  
2 search one or more files includes using said object identifier to search one or

3 more files generated from a Management Information Base file that contains  
4 said Management Information Base object.

1 13. The method of Claim 11 wherein the step of generating Hypertext Markup  
2 Language text for an entry includes the steps of:  
3 transmitting a query to said third software layer to retrieve a current value  
4 associated with a second Management Information Base object, said  
5 second Management Information Base object being a component of  
6 said Management Information Base object that is identified in said  
7 entry; *A*  
8 receiving from said third software layer said current value associated with said  
9 second Management Information Base object; and  
10 generating Hypertext Markup Language text that, when decoded by an HTTP  
11 client, causes the HTTP client to generate a display that identifies said  
12 second Management Information Base object and displays said current  
13 value of said second Management Information Base object.

1 14. The method of Claim 13 wherein the step of generating Hypertext Markup  
2 Language text for said entry further includes the steps of generating an anchor  
3 that contains a second MIB object identifier, wherein said second MIB object  
4 identifier uniquely identifies said second MIB object.

1 15. The method of Claim 14 further comprising the steps of:

2 said second software layer receiving from said first software layer said second  
3 MIB object identifier and a new value for said second MIB object in  
4 response to a user selecting said display that identifies said second  
5 MIB object; and  
6 said second software layer transmitting command to said third software layer  
7 to cause said third software layer to update configuration data  
8 associated with said second MIB object to said new value.

1 16. The method of Claim 7 wherein:

2 the user input that specifies a change to configuration data associated with a  
3 MIB object; *A*  
4 said second software layer generates an HTML document which includes  
5 HTML text for identifying said MIB object and for displaying a new  
6 value for said MIB object;  
7 said second software layer transmits said HTML document to said first  
8 software layer; and  
9 said first software layer generates an updated display based on said HTML  
10 document, wherein said updated display identifies said MIB object and  
11 displays said new value for said MIB object.

1 17. The method of Claim 16 wherein said second software layer generates said  
2 HTML document with an anchor that includes a MIB object identifier of said  
3 MIB object.

1 18. The method of Claim 7 wherein:  
2 the user input that specifies a change to configuration data associated with a  
3 MIB object; and  
4 the first message includes a MIB object identifier of said MIB object.

1 19. An access device having embedded therein:  
2 a combined text-interface generator and HTTP client;  
3 a combined HTTP server and SNMP manager; and  
4 an SNMP agent;  
5 wherein the SNMP agent has direct access to configuration data stored in said  
6 access device;  
7 wherein the combined HTTP server and SNMP manager only accesses said  
8 configuration data by sending messages to said SNMP agent; and  
9 wherein the combined text-interface generator and HTTP client only accesses  
10 said configuration data by sending messages to said combined HTTP  
11 server and SNMP manager which cause said combined HTTP server  
12 and SNMP manager to send messages to said SNMP agent.

1 20. The access device of Claim 19 wherein:  
2 the combined HTTP server and SNMP manager generates HTML documents  
3 that include anchors that contain identifiers for MIB objects; and



4 the combined text-interface generator and HTTP client transmits to the  
5 combined HTTP server and SNMP manager messages that contain  
6 identifiers for MIB objects in response to input received from a user.

1 21. A method for automatically generating HTML based on MIB information, the  
2 method comprising the steps of:  
3 receiving from an HTTP client a message that identifies a MIB item;  
4 reading said MIB information to determine a type of said MIB item;  
5 requesting a current value from an SNMP agent for said MIB item;  
6 generating an HTML page which, when decoded by the HTTP client, causes  
7 the HTTP client to generate a display that indicates the current value for  
8 said MIB item; and  
9 transmitting the HTML page to the HTTP client.

1 22. The method of Claim 21 wherein:  
2 the step of receiving from an HTTP client a message that identifies a MIB item  
3 includes receiving a message that identifies a row in a MIB table;  
4 the step of reading said MIB information to determine a type of said MIB item  
5 includes reading said MIB information to determine the type for each  
6 MIB variable in the row;  
7 the step of requesting a current value from an SNMP agent for said MIB item  
8 includes requesting current values for each MIB variable in the row;

9 the step of generating an HTML page includes generating an HTML page  
10 which, when decoded by the HTTP client, causes the HTTP client to  
11 generate a display that indicates the current values for at least one MIB  
12 variable in the row.

1 23. The method of Claim 21 wherein:  
2 the message includes a string of text that indicates a file name; and  
3 the method further includes the step of reading from the string of text  
4 arguments that identify the MIB item.

1 24. The method of Claim 23 wherein the step of generating said HTML page  
2 includes replacing text from a template HTML page with text that is based on  
3 said arguments.

1 25. The method of Claim 23 wherein the step of generating said HTML page  
2 includes inserting into an anchor of said HTML page text that is based on said  
3 arguments.

1 26. The method of Claim 21 wherein:  
2 the step of generating said HTML page includes generating an anchor in said  
3 HTML page that includes a command;  
4 the method further includes the steps of

the command from the H  
ertext link associated with  
ing a request for an SNMP  
response to receiving the co  
aim 26 wherein:  
includes an identifier of a  
itting a request to the SNM  
r the variable correspondi  
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